

Appendix G

Emission Benefit Calculations

Appendix G Emission Benefit Calculation Methodologies

Emission Benefits from New School Bus Purchases

The staff used the ARB's emission inventory modeling program, EMFAC2002 (April 2003 version), to estimate the emission benefits associated with replacing pre-1977 model year school buses with 2007 model year buses. The base assumptions derived from EMFAC2002 are:

- A pre-1977 model year bus accrues about 40 miles per day and emits about 1.9 pounds per day of NO_x and 0.09 pounds per day of PM.
- A 2007 model year bus accrues about 40 miles per day and emits about 0.3-0.4 pounds per day of NO_x and 0.03 pounds per day of PM.

Consequently, for each pre-1977 model year bus replaced with a new bus (2007 model year), about 1.5 pounds per day of NO_x and 0.06 pounds per day of PM are reduced. With funds available to replace about 90 buses (i.e., \$12.5 million in total funding at a cost of \$140,000 per bus), total emission reductions would be about 135 pounds per day of NO_x and 5 pounds per day of PM.

These are immediate, near-term reductions due to fleet turnover – the new bus has significantly lower emissions than the old bus. These benefits continue only as long as the old bus would have remained on the road. The ARB staff is currently assessing the length of time that the old bus would have remained on the road and the potential lifetime emission benefit through a fleet modernization program that is part of the Carl Moyer Program.

In cases where a pre-1977 model year bus is replaced with a 2007 model year alternative-fueled bus, the alternative-fueled bus is certified to a lower NO_x standard than is required by regulation. This means that an alternative-fueled bus replacement will provide an additional NO_x emission reduction of about 0.1 pounds per day. This additional emission benefit would last for the lifetime of the new bus.

Emission Benefits from In-Use Diesel Retrofits

Passive DPFs use the heat generated from the engine to catalytically oxidize collected diesel PM. Active DPFs use an external source of heat to oxidize collected PM with or without the aid of a catalyst.

There are several models of passive DPFs ARB-verified for installation on school buses in California. These passive DPFs are only verified for 1994 and later model year engines. Currently, there is one ARB-verified uncatalyzed active DPF for use on school buses; however, it is also only verified for 1994 and later

model year engines. We expect that this active DPF will be ARB-verified in the near future for 1988 through 1993 model year engines as well.

The ARB staff calculated emission reductions from the installation of ARB-verified retrofit devices on in-use diesel school buses. In this analysis, the staff included both active and passive Level 3 DPFs (technologies that achieve an 85% or greater reduction in PM emissions) in order to capture the largest population of school buses eligible for retrofits. The staff estimates that the \$12.5 million in 2005-2006 fiscal year State funds will fund about 860 retrofit devices for in-use diesel school buses. For purposes of this analysis, the staff assumed:

- A Level 3 DPF, whether active or passive, has an 11 year life
- Active DPFs are installed on 1988-1993 model year buses and passive DPFs are installed on 1994 through 2004 model year buses
- Each retrofitted bus travels approximately 15,000 miles per year (according to EMFAC2002, the actual mileage rate is 14,836 miles per year)
- Typical cost for an active DPF is about \$18,500, including installation, infrastructure, and periodic maintenance (de-ashing and baking to burn off unoxidized PM)
- Typical cost for a passive DPF is about \$12,000, including installation and periodic maintenance (de-ashing and baking to burn off unoxidized PM)

Using the above assumptions, the staff estimates that retrofits on in-use diesel buses will reduce PM emissions by 45 to 60 tons over the expected 11 year DPF life. To the extent that active DPFs are also installed on the eligible 1994 through 2004 model year school bus population, the number of funded retrofits and total emission benefits will decrease due to the higher costs of active DPFs.